Saving lives through real-time flood forecasting

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In October 2013, Austin, Texas experienced record levels of flooding. The historic Onion Creek Halloween floods caused several deaths, devastated hundreds of homes, and nearly $30 million in damage. Because of the slow response time, Austin's first responder community was heavily criticized, but issues in flood prediction systems may have been to blame.

Current flood prediction systems in the United States are centered on large rivers and responses to rain patterns and often do not provide enough information on the individual streams and rivers that impact flooding in communities.

David Maidment, a hydrologist and civil engineer at The University of Texas at Austin, knew there was a better way to predict flooding using advanced technology. With a grant from the National Science Foundation, he developed the National Flood Interoperability Experiment (NFIE). NFIE is a collaboration between the academic community, the National Weather Service and its government partners, and commercial partners to develop a transformational suite of science and services for national flood hydrology and emergency response.

Maidment and other researchers presented NFIE at the first-ever White House Water Summit in late March. The summit highlighted the importance of collaborative and creative strategies to solve water challenges nationwide.

For Maidment's improved system, the researcher integrated information on rain patterns, creeks, streams, and rivers across the country to forecast floods continually. Because of the volume of data needed to accurately predict flooding, Maidment and his team turned to advanced computing resources at the Texas Advanced Computing Center (TACC).

"That's how I got involved with TACC. We could already simulate flooding in the Mississippi basin, but it took 19 hours and I wasn't sure if we could scale the entire country," Maidment said.

Through XSEDE's Extended Collaborative Support Service (ECSS), the researchers not only received an allocation on TACC's most powerful supercomputer, Stampede, but support from TACC research associate, Si Liu. ECSS pairs researchers with expert staff members in advanced computing to assist with issues ranging from performance analysis to code optimization to visualization.

With Liu's expertise, the researchers addressed a computational bottleneck and implemented a new data structure, algorithm, and workflow, which enhanced the code's performance by a factor of over 10,000. This breakthrough improved the national stream flow simulation model from 10 hours to 3.5 seconds in predicting floods.

"This collaboration shows that the success of high performance computing systems are not just by providing the big iron, it has to do with optimizing the code," Maidment said.

Maidment is also collaborating with the first responder community to ensure that the project has a real impact and can be used to save lives. Harry Evans, a research fellow at UT Austin is the former chief of staff of the Austin Fire Department and liaison between the academic and first responder communities.

"From my perspective, I'm excited that for once I'll be able to find a way to give emergency managers, fire chiefs, rescuers, real scientific data they can use to make decisions," Evans said. "Before, they made decisions based on institutional knowledge, historical background, and experience from running previous calls."

Evans and Maidment have been educating decision makers and politicians about the importance of flood forecast system on both the local and national level. "Nobody had a clue it was possible," Maidment said. "And you better believe, predicting floods in 10 minutes for the whole country has generated waves in Washington."

Provided by University of Texas at Austin